Agenda for Well Construction Review in Garfield County

- Provide Background for Wellbore Analysis (technical notes)
- Walk through COGCC website
  - NTO's (policy link)
    - Bradenhead Pressure Reporting-Garfield County (Mamm Creek & Rulison Fields) Mesa County (Buzzard Field) (07/08/2010)
    - Piceance Rulison Field - Notice to Operators (06/23/2006)
    - Mamm Creek Field Area Notice to Operators revised February 09, 2007))
    - NW Colorado Notification Policy (05/10/2012)
      Effective for notices received on or after January 1, 2010
  - Bradenhead Test results (library link)
  - Well Data (database link)

- Well Review

(b) (5) [redacted]

Worksheet: Annular Flow 1
Well: Twin Creek 12-2D2
Pad: O1EB
API: 05-045-19553

Worksheet: T6S R91W sec31
Well: GGU Miller #22D-31-691
Pad: Gibson Gulch Unit Pad (13 wells)
API: 05-045-14312

(b) (5) [redacted]

Worksheet: Annular Flow 4
Well: Jolley 17-25D
API: 05-045-17265

Worksheet: T6S R91W sec32
Well: GGU Barge #12C-32-691
API: 05-045-17265

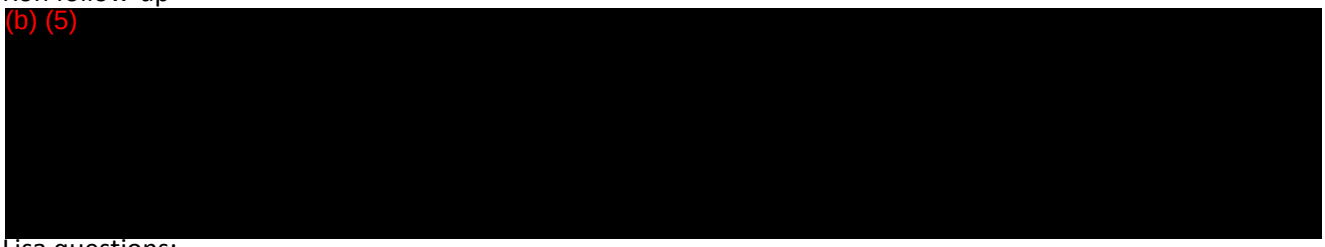
Worksheet: Annular Flow 4
Well: Fed. KP 44-18
Pad: KP 34-18 PAD (9 wells)
API: 05-045-20632
Fluid: "Would not blow dead, H2O would not stop" (130 psi initial/100 psi final)

Bracken concerns:

- EnCana published document eluding to “pre-existing conditions” for 2008 seep
    - Concludes gas completely biogenic
- F12E Pad (Jan 2012): wants a hydrological review of production area
- New soil/gas data shows methane and heavier HC releasing into West Divide Creek
- 2004 seep cause not identified and still active: benzene and other toxics being released into shallow aquifer of West Divide Creek that supplies domestic and agricultural water and major tributary of CO River
- 2010 Moon and Miller water well investigation excludes 2008 seep area: wants monitoring wells to investigate 2008 seep
- 2010 soil gas survey by EnCana mapping methane expression; would like a follow up sampling event to be compared against
- Ethane found in beaver ponds reported by COGCC and EnCana as lab errors
- Don Kaufman’s property had seep impacts in 2004: fish kill
- 2004 seep: EnCana purchased Dietrich (now Moon property?) and Scherowsk property; Lloyd well also contaminated—attributed to Arbany kick --COGCC and EnCana don’t agree on thermo vs biogenic gas
- Bracken seep and water well have been excluded from both Phase I and II of the study
- Bracken seep not included in USGS study

Ron follow-up

(b) (5)



Lisa questions:

- Were samples collected in the correct place during EnCana’s 2010soil gas sampling event
- Twin Creek monitor is close to 2008 seep—what is the number form map that represents that well

(b) (5) [redacted]

Worksheet: Annular Flow 1
Well: Twin Creek 12-2D2
Pad: O1EB (15 wells)
API: 05-045-19553

Surface Casing: 1164 feet
Production Casing: 6145 feet
Williams Fork: 3634 feet
TOC$_{CBL}$: 1162 feet

Note: No pressure or fluid flow reported during annual BH test

(b) (5) [redacted]

Worksheet: T6S R91W sec31
Well: GGU Miller #22D-31-691
Pad: Gibson Gulch Unit Pad (13 wells)
API: 05-045-14312

Surface Casing: 745 feet
Production Casing: 7261 feet
Williams Fork: 3341 feet
TOC$_{CBL}$:

(b) (5) [redacted]

Worksheet: Annular Flow 4
Well: Jolley 17-25D
API: 05-045-17265

Surface Casing: 1034 feet
Production Casing: 7925 feet
Williams Fork: 3823 feet
TOC$_{CBL}$:

Notes: X-over @ 2098', 2215', 2344', 2425', 2524', 2560', 2945', 3623', 3682', 3771'
Cmt. Squeeze @ 1300' w/200 sx. Excellent bond fr/ 1034' to 1200'. Poor bond to 2480'. Poor to fair bond to 3890'. Generally, good to excellent bond to TD.

(b) (5) [redacted]

Worksheet: T6S R91W sec32
Well: GGU Barge #12C-32-691

Pad:
API: 05-045-17265

Surface Casing: 786 feet
Production Casing: feet
Williams Fork: 3285 feet
TOC$_{CBL}$: 3632

Good to excellent bond fr/TOC to TD.
1632, 1778, 1911, 2464

(b) (5) [redacted]

Worksheet: Annular Flow 4
Well: Fed. KP 44-18
Pad: KP 34-18 PAD (9 wells)
API: 05-045-20632
Fluid: "Would not blow dead, H2O would not stop" (130 psi initial/100 psi final)

Surface Casing: 1235 feet
Production Casing: 7450 feet
Williams Fork: 3568 feet
TOC$_{CBL}$: 4009 feet; Fair bond fr/ 4009' - 4770'. Generally, excellent bond to 7450'.

No open or cased-hole porosity or saturation logs above Williams Fork on this well.

Wells on Pad KP 34-18

1. **Kokopelli Fed. 18-213D**
   - Spud Date
   - Surface Casing: 847 feet
   - Production Casing: 7440 feet
   - TOC: 1624 feet
   - X-over @ 1232', 1498', 1563', 1665', 1931', 2460', 2488', 2509', 2546', 3629', 3650'
   - Open Annulus: Wasatch
   - BH results: 90 psi initially; "blew down instantly"

2. **Kokopelli Fed. 18-215D**
    - Spud date
    - Surface Casing: 1032 feet
    - Production Casing: 7451 feet
    - TOC: 2090
    - X-over @ 1680', 1933', 2553'. 2677', 3570', 3637', 3655', 3668'
    - Open Annulus: Wasatch
    - BH results: 90 psi initially; "Would not blow down, had a slight blow"
    -

3. **Kokopelli Fed. 18-313D**
    - Spud date
    - Surface Casing: 845 feet
    - Production Casing: 7180 feet
    - TOC: 1691 feet
    - X-over @ 1500', 1508', 1680', 1920', 2078', 2197', 2348', 2365', 2406', 2450', 2601', 3007', 3360, 3444
    - Open Annulus: Wasatch
    - BH results: 40 psi initially; "blew down in 1 minute"

4. **Fed. KP 433-18**
    - Spud date
    - Surface Casing: 822 feet
    - Production Casing: 7356 feet
    - TOC: 4090 feet
    - No open or cased-hole porosity or saturation logs above Williams Fork
    - Poor bond fr/ 4090' - 5020'. Fair bond to 5280'. Generally, excellent bond to TD
    - Open Annulus: Wasatch, Williams Fork
    - BH results: 140 psi; "Would not blow dead, brough some H2O"

5. **Fed. KP 533-18**
    - Spud date
    - Surface Casing: 993 feet
    - Production Casing: 7269 feet
    - TOC: 1483 feet
    - X-over @ 1067', 1721', 2397'
    - Open Annulus: Wasatch
    - BH results: 40 psi initially; Blew down with gas but would not stop bringing H2O

6. **Fed. KP 544-18**
    - Spud date
    - Surface Casing: 1134 feet
    - Production Casing: 7288 feet
    - TOC: 2152 feet
    - Top of FDC-CNL @ 4900'. No log in Wasatch
    - Open Annulus: Wasatch
    - BH results: 20 psi initially; Blew down but would not stop bringing fluid

7. **Fed. KP 14-18**
    - Spud date
    - Surface Casing: 1374 feet
    - Production Casing: 8190 feet
    - TOC: 3570 feet
    - Open Annulus: Wasatch
    - No open or cased-hole porosity or saturation logs above Williams Fork.
    - Fair bond fr/ 3570' to 4140'. Poor bond to 5400'. Fair bond to 2950'. Good to excellent bond to 6658'. Perforated @ 4986', 4752', & 4250'. Sqzd perfs w/ a total of 550sx
    - BH results: 110 psi initially; Would not blow dead, brought small amount of H2O

8. **Fed. KP 24-18**
    - Spud date
    - Surface Casing: 1318 feet
    - Production Casing: 7551 feet
    - TOC: 3084 feet
    - Open Annulus: Wasatch
    - No open or cased-hole porosity or saturation logs above Williams Fork.
    - Poor bond fr/ 3084' to 4970'. Fair to good bond to 5230'. Excellent bond to TD
    - BH results: 60 psi initially; Blew down in 2 minutes, brought small amount of H2O at the end

INTERNAL DOCUMENT—DELIBERATIVE PROCESS

Notes from Mamm Creek Discussion with COGCC
December 17, 2012

Here is what we heard from COGCC:

- COGCC doesn't believe that the lower Wasatch (from 1000' down to the Ohio Creek formation) has been demonstrated, on the basis of data, to be a USDW. They have tried to do evaluation of logs to define the lower limit of 10,000 TDS water, but weren't able to do this. Also, they argue that the individual sandstone lenses may be less likely to provide a yield capable of supplying a PWS. They clearly focus on equating useable freshwater with water that is currently being used.
- 2800 gas wells have bradenhead analysis; of these, 57 were identified as having potential migration concerns based on showing bradenhead pressure >150 psi or having fluid flowing at the surface. COGCC then looked at construction of the 57 'problem' wells. They assert that this analysis showed no correlation between bradenhead pressure and poor bond or open holes; i.e. there were proportionally as many wells with open annuli and/or shallow surface casing in the 'no problem' group as there were in the 'problem' group of 57. From this, they have concluded that cementing off the Wasatch does not eliminate fluid migration issues.
- COGCC also argues that leaving the annuli open allows for ongoing monitoring of potential cement bond issues that would go undetected if that monitoring weren't available.
- COGCC asserts that cementing through the Wasatch is problematic.

Additional notes:

New Well Construction

- They now require TOC outside the production casing to go 200' above the top of the Mesa Verde/Ohio Creek.
- Surface casing is typically 1000-1500' in new wells, driven by the 10% or 15% of total depth requirement. Shallowest surface casing is in the 600-750' range.
- The 15% applies only in the pink Divide Creek well control area (along the Mamm Creek anticline- I couldn't tell how this was defined or if it corresponds to any of the mapped areas where the different NTOs apply…)
- The 10% applies in the rest of Garfield County. These two requirements override the x+50 language that I guess is standard statewide?
- I think that both of these requirements were said to be established for well control purposes rather than protecting GW.
- Intermediate casing is only required where they believe it necessary for well control.
-
- Existing well issues
- Only a 'handful' of wells have been required to implement remedial cementing. Most of the 57 'problem' wells are just venting and monitoring.

(b) (5) [redacted]

Commented [G3]: From API "The primary method used for protecting groundwater during drilling operations consists of drilling the wellbore through the groundwater aquifers, immediately installing a steel pipe (called casing), and cementing this steel pipe into place. All state drilling regulations specifically address groundwater protection, including requirements for the surface casing to be set below the lowest groundwater aquifer, or USDW (DOE [2], 2009 and IOGCC [1], 2007). The steel casing protects the zones from material inside the wellbore during subsequent drilling operations and, in combination with other steel casing and cement sheaths that are subsequently installed, protects the groundwater with multiple layers of protection for the life of the well."
"The design basis for well construction emphasizes barrier performance and zonal isolation using the fundamentals of wellbore preparation, mud removal, casing running, and cement placement to provide barriers that prevent fluid migration. The selection of the materials for cementing and casing are important, but are secondary to the process of cement placement. The performance of the barrier system to protect groundwater and isolate the hydrocarbon bearing zones is of utmost importance."
"After the casing has been run into the drilled hole, it must be cemented in place. This is a critical part of well construction and is a fully designed and engineered process. The purpose of cementing the casing is to provide zonal isolation between different formations, including full isolation of the groundwater and to provide structural support of the well. Cement is fundamental in maintaining integrity throughout the life of the well and part of corrosion protection for casing."
" The surface hole is typically drilled to a predetermined depth based on consideration of the deepest groundwater resources and pressure control requirements of subsequent drilling. The surface hole should be drilled using air, freshwater, or freshwater-based drilling fluid. This setting depth can be from a few hundred feet up to 2000 ft deep or more. The surface casing is usually set at a depth sufficient to ensure groundwater protection. State regulations dictate the minimal setting depth of surface casing, and the vast majority of states require the casing to be set below the deepest groundwater aquifer. At a minimum, it is recommended that surface casing be set at least 100 ft below the deepest USDW encountered while drilling the well."
"It is recommended that the surface casing be cemented from the bottom to the top, completely isolating groundwater …

(b) (5) [redacted]

Commented [G5]: 15% of 6000ft is only 900ft

(b) (5) [redacted]

INTERNAL DOCUMENT—DELIBERATIVE PROCESS

- Any well that had fluid flowing at the surface is required to do remedial cementing. They require the operator to start at the TOC and work their way up from there, using neutron density logs to guide the process.
- There are 6000+ water wells and 6000+ gas wells (was this just in Garfield Co?)
- I thought I heard that both thermogenic and biogenic methane is naturally present in the Wasatch?

(b) (5)

Commented [G11]: That is what Stuart asserted, however if you read the USGS 2010 report it specifically states that thermogenic gas does is not produced in the Wasatch it migrates there either through natural geologic features allowing migration from the Mesa Verde into the Wasatch or by uncemented well bore annuluses.

Well Name	operator	Type	Lat	Long
TWIN CREEK #12-2D2 (O1EB)	EnCana	(b) (5)	39.471433	-107.612584
GGU MILLER #22D-31-691	Bill Barrett		39.48497	-107.60046
KP 34-18 PAD (9 wells)	WPX			
Jolley 17-25D	EnCana			
GGU Barge #12C-32-691				

API

05-045-20632
05-045-17265
05-045-15918